ELECTRIC AUTO ASSOCIATION NEWS

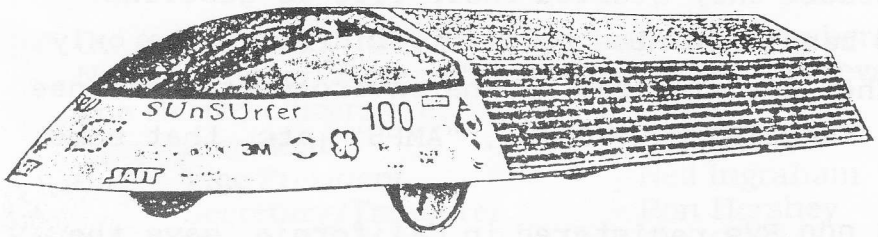
September 1990 Vol. XXIII NO. 9

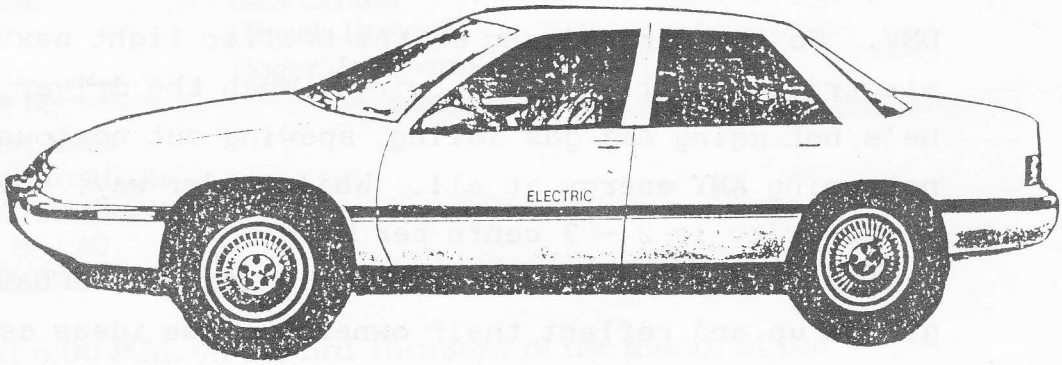
18th Annual

Electric Car Rally

Presented by the ELECTRIC AUTO ASSOCIATION

(Santa Clara Chapter)





Come and ride in the Cars of the Future

---Ride in a real street legal Electric Car

---See the Stanford students' Solar Powered car (SUn SUrfer) that won the Aug. 11 solar car race in Willits CA.

When--Sat. Sept. 15th, 1990
9:30 am to 4:00 pm
Location-- Start / Finish at 1184 N. Matilda, Sunnyvale CA.
between Lockheed bldg. #560 &561
(1 1/2 blks north of the "Blue Cube")

For more information, call Lee Hemstreet 415-493-5892
or Paul Brasch 408-371-5969

ELECTRIC AUTO ASSOCIATION

(Santa Clara Chapter)

PRESS RELEASE - Sept. 5, 1990

NON-PROFIT ORGANIZATION

Sunnyvale, Ca.

WHO CARES ABOUT GAS PRICES?

In the heart of the Silicon Valley, the center of technology and innovation there are people who don't care how high gas prices go. In fact the grin on their faces widens the more it increases. Why? Do they own oil stock? No. They drive electric cars that don't pollute, smell bad or contribute to the global warming gases. And they can be "refueled" (recharged) at home in addition.

Many of these electric vehicles (EVs) look and behave like any other car on the road, because they started their life as gasoline powered cars but have now been converted to electric drive. The only visible indication that they are electric is the environmental license plates reading "NOT GAS", "ELECTRIC", "VOLTS", "AMPS", etc. that some owners display.

There are more than 36,000 EVs registered in California, says the DMV. So the car waiting at the traffic light next to you could be electrified without you knowing. When the driver is stopped in traffic he's not using ANY gas idling, spewing out noxious fumes. In fact he is not using ANY energy at all. While under way, the cost for the electricity is 2 - 3 cents per mile.

Not all electrics are common looking. Some have been built from the ground up and reflect their owners unique ideas as to what makes the perfect car. Some normal looking EVs and some very unusual looking ones will be on display and giving free rides to the public at the 18th annual Electric Car Rally in Sunnyvale on Sat. Sept. 15 from 9:30 am to 4:00 pm at 1184 N. Matilda. There will be Solar Powered EVs as well as a score or more of more normal street legal cars to ride in, and other displays of electric vehicle technology.

So who cares about gas prices? Everyone does, but some of us look *FORWARD* to higher prices because they contribute to making this the decade that the electric car recaptures the marketplace from the old style, complex, costly and smelly, smog belching gas guzzler.

Paul H. Brasch, President Electric Auto Association - Santa Clara
1968 Elden Drive, San Jose, CA. 95124-1313 408-371-5969

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WELCOME! NEVADA CHAPTER

From: Jim Cullen
Desert Research Institute
Suite 1, 2505 Chandler Ave.
Las Vegas, NV 89120

Date: August 17, 1990

On August 16th, 1990 scientists and staff members of the University of Nevada's Desert Research Institute formed the Nevada Chapter of the EEA. The elected officers are:

President	Gail Lucas
Vice President	Neil Ingraham
Secretary/Treasurer	Ron Hershey
Newsletter Editor	Jim Cullen
Fund Acquisition	Chuck Russell
	Roger Jacobson

The chapter's address is:

Nevada Chapter, EAA
Desert Research Institute
Suite 1, 2505 Chandler Ave.
Las Vegas, NV 89120
Voice mail: 702-594-9798

The group will meet at 6:00 P.M. on the 3rd Thursday of the month at the chapter address.

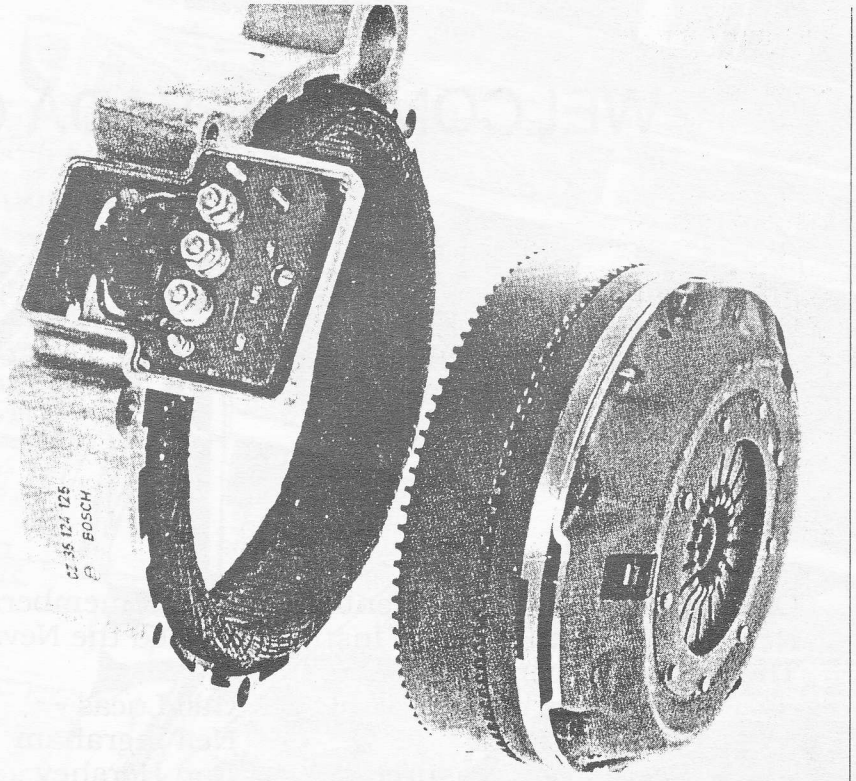
World Record for Solar Cells

The Solar Energy Research Institute (SERI) has announced a new world record for size and output for a monolithic thin-film amorphous photovoltaic panel. It delivers 63 watts when its 13 square feet is exposed to the sun. Such panels are laid down on a glass plate by depositing the active materials and interconnects in one production sequence. This panel was produced by Chronar Corp. as part otr a research consortium that includes SERI, Energy Conversion Devices, ARCO Solar and Solarex. The goal of the consortium is to provide cost-effective peak power for electric uilities. (*Popular Science*, March 1990)

DUAL-POWER AUTOS TAKE THE WHEEL

Cleaner-burning, more energy-efficient, and quieter than conventional cars, hybrid vehicles combine the best features of internal combustion engines and electric designs.

Bill Siuru
Contributing Editor
Colorado Springs, Colo.



Combined design. The Hybriddrive's asynchronous motor/generator and its two clutches are extremely compact. The unit replaces the flywheel, starter, alternator, and normal clutch, adding little to the length or weight of the drivetrain.

No alternative means of automotive propulsion has yet been found that approaches the performance or versatility of the internal combustion engine. Electric vehicles (EVs) may be okay around town, but may never be popular with people who want to, or have to, use cars for long-range, high-speed transportation.

As an example of how much energy is packed into gasoline, some quick calculations will show that it provides the equivalent of 12,000 watt-hours per kilogram. Compare this to a current-day lead-acid battery, which provides only about 40 watt-hours per kilogram and you see the challenge proponents of EVs are facing. Some calculations by Audi engineers show that if a battery-powered car were to have the same energy content (about 200 kW-hr) as one using an internal combustion engine burning a tankful of gasoline, it would weigh about four tons. While major improvements are on the horizon to increase the energy content of batteries, it is obvious that they will never reach the levels obtained quite easily with internal combustion engines.

Nevertheless, electric vehicles are virtually noiseless and pollution-free, and are very good at conserving energy. Because of this they will see ever-increasing use, undoubtedly spurred on by government mandates. For example, by the year 2010, 70 percent of all vehicles in smog-conscious southern California must be electric-powered to meet clean air standards set by the South Coast Air Quality Management District. Research by that district has shown that EVs are 97 percent less polluting than gasoline-powered cars, even when the emissions from the power plants producing electricity for recharging are considered.

The way to satisfy the need for cleaner-burning, more-energy-efficient, and quieter vehicles that still will satisfy consumer demands for performance may be the hybrid vehicle that capitalizes on the best features of both. Currently, the hybrid vehicles under consideration range from electric vehicles that use another means of propulsion, usually a small internal combustion engine for "range extension," to cars with gasoline or diesel engines that are augmented by electric propulsion systems for urban driving.

Of the three companies recently selected in the "L.A. Initiative" to bring up to 10,000 EVs into the Los Angeles basin by 1995, two will be using hybrid vehicles with small "range extender" auxiliary power plants. Only the Electric G-van produced by Canadian-based Vehma International is a pure electric vehicle. The Electric G-vans are full-sized, conventional G.M. vans converted to electric propulsion using lead-acid batteries and a 52-horsepower dc motor.

Model M-90

The Uniq Model M-90 developed by Unique Mobility Inc. (Englewood, Colo.) is a Chrysler minivan converted to electric power. The range extender is a Honda 2-cylinder, 4-stroke, 12-horsepower, water-cooled engine that runs on liquid propane, natural gas, or methanol. Maximum efficiency is obtained by operating the internal combustion engine at constant speed in two power ranges with no idle condition, i.e., it operates only while producing useful power. The power levels are 3 kW for pure range extension and 5 kW for range extension with the air conditioner operating.

The range extender engine drives a shaft-mounted, Uniq high-frequency, 3-phase ac alternator whose output is converted to regulated dc. This is fed into a common electrical bus for distribution to the main motor, recharging the battery, and powering the air conditioner.

The M-90 uses 18 lead-acid batteries with sealed, low-maintenance gelled electrolyte. An 80-horsepower shunt-wound dc motor provides the main power and operates in conjunction with a solid-state controller. The M-90 has two speeds, forward and reverse, and is front-wheel driven. Regenerative braking is used to recover energy for battery recharging.

The M-90, which has a gross vehicle weight of 6000 pounds, has a top speed of a 70 mph and a 0-to-30-mph acceleration of 8.5 seconds. The range under normal driving conditions is over 100 miles with the auxiliary engine being used when needed. The company plans to begin producing the M-90 in the late summer of 1990 with its first vehicles going to commercial fleet operators in the Los Angeles basin.

Clean Air's LA 301

Clean Air Transport, based in Sweden and England, will produce the LA 301 in four-passenger car, two-seat microvan, and two-seat pickup form. The LA 301 is based on

the $5 million Whisper EV project, a third of which was funded by the Danish government. Some 30 Whisper I EVs were built and demonstrated extensively in Europe, the United States, and the U.S.S.R.

The LA 301 uses lead-acid batteries, a 12-kW (16-hp) dc motor, and a propane-fueled range extender, called an auxiliary power unit to achieve a maximum range of 150 miles and a top speed of 60 mph. The expected range on pure electric power is only 65 miles. The advanced styled vehicles will use a fiberglass body over a space-frame chassis. The LA 301 would feature front-wheel drive, regenerative braking, and air conditioning. Projected gross vehicle weight is 3300 pounds.

Alupower Canada Ltd. (Kingston, Ontario) and Unique Mobility are developing an EV that will use an aluminum-air fuel cell for range extension. That cell generates electrical power by means of the electrochemical reaction between aluminum and oxygen in the air. An alkaline electrolyte is pumped through the cell stack between the aluminum anodes and air cathodes. Electricity is produced as the aluminum oxidizes. Aluminum hydroxide is formed as a by-product and is gradually precipitated out and collected in a sump. A stream of air is blown through the cell stack to supply the oxygen for the electrochemical reaction. Because the aluminum is eventually consumed, the cell is recharged by replacing the aluminum anode plates. At the same time, the electrolyte is replenished. The aluminum hydroxide can be collected and recycled by processing it back to metallic aluminum. The end result is a clean, nonpolluting, and renewable power source.

Besides the individual cells, the system requires a pumping system for the electrolyte and a blower for moving the air through the air cathode. Oxygen-depleted air is removed from the system by the condenser, and the heat exchanger keeps the temperature of the electrolyte at approximately 60° C.

The aluminum-air fuel cell is based on technology developed by Alcan's Kingston (Ontario) Research and Development Centre. Alupower's initial application is in an emergency power supply system for telecommunication networks. There the air-fuel cells are used to supply power for long-term outages of 50 to 250 hours, while ordinary lead-acid batteries are used for short-duration requirements. This combination is needed because it takes about 30 minutes for the aluminum-air battery to reach its full power capacity. The system has a potential storage lifetime of 10 years.

Audi duo. The duo, a modified Audi 100 Avant Quattro, uses a gasoline engine to drive the front wheels and a small electric propulsion system to drive the rear wheels.

While the aluminum-air fuel cell has high energy density—more than 350 watt-hours per kg—it has a low power density. Therefore, it cannot be used alone for propulsion, but must be used with another power source such as lead-acid batteries.

The 6-kW aluminum-air fuel cell now being developed by Alupower is specifically for range extension. The 48 fuel cells will be combined with 18 chloride 3ET-205 6-volt lead-acid batteries to drive an 80-horsepower dc motor. All this will be installed in a Chrysler minivan converted for electric power by Unique Mobility. The range of this EV should be extended from around 50 miles to almost 190 miles with a top speed of 60 mph. While the lead-acid batteries would be recharged normally, the aluminum-air ones would be recharged by replacing most of the active components such as the anode and cathode.

This is not the first application of the aluminum fuel cell for range extension. Alcan and Unique Mobility installed a system of eight lead-acid batteries and two aluminum-air fuel cells in a Unique Mobility Electrek car. In this case, the aluminum-air fuel cell system was the one used in the telecommunications emergency power supply system. With this initial system, the EV had a range of over 200 miles compared to a range of 75 miles with 16 lead-acid batteries alone. At the same time, the total vehicle weight went down about 50 pounds because the total battery weight was reduced.

One of the challenges of an aluminum-air system is reducing operating costs, which are now estimated to be about 21 cents per mile. This can be reduced by running the car on the

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BRIEFLY STATED

ELECTRIC CAR STUDY

A study ordered by the Swiss government says that electric cars offer so many advantages that their introduction should be encouraged by official measures and policies. The study says the widespread use of electric cars--often partly powered by solar energy--would result in positive effects such as cleaner air, less noise pollution and energy economy, but only if electric cars replace part of the present fleet of gasoline powered second cars. Therefore, the government should take steps to encourage the use of electric cars in urban areas, it says. (Solar Energy Intelligence Report)

main battery for short trips and using the fuel cells for less frequent long trips. Then the aluminum anodes do not have to change at every recharge. The use of smelter-grade aluminum can also bring costs down. Alupower is optimistic that the cost of cathodes, one of the chief barriers to the use of aluminum-air batteries to date, will also fall in the future.

German Entries

Both Audi and VW have developed hybrid vehicles that give up little of their high performance but still can operate where there might be restrictions on the use of internal combustion engines.

Audi, in conjunction with Pöhlman (Kulmbach, West Germany) has developed a rather unique hybrid vehicle. The Audi "duo" concept car is an Audi 100 Avant Quattro with four-wheel drive that retains its gasoline engine to drive the front wheels. It carries the duo label on the body, which identifies it as a hybrid. However, Audi has added a small electric propulsion system in the rear to drive the rear wheels. A 12.6-horsepower electric motor fits into the transmission tunnel after the propeller shaft has been removed. The motor weighs 132 pounds and is coupled directly to the rear differential via an electrically operated clutch. While the car is operating on this electric motor, another smaller electric motor is used to supply hydraulic power for the power steering, power brakes, and antilock brake system.

The 400-pound battery pack, located in the spare tire well, uses a high-performance nickel/cadmium battery pack with 49 cells that supply 1.2 volts per cell. The battery has a life of at least 10 years. An auxiliary gasoline- or diesel-fired water heater is used for interior heating while the car is running on its batteries.

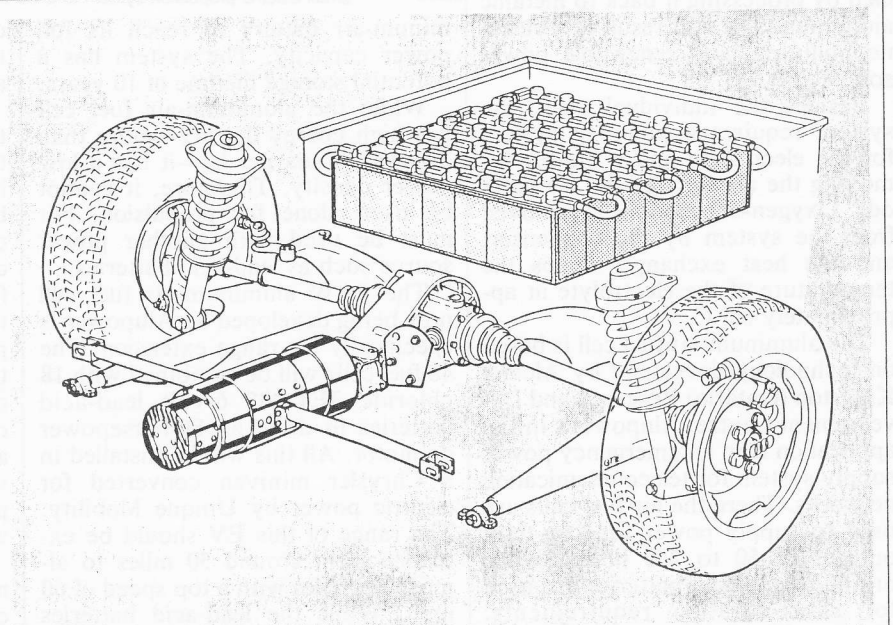
Turning the key either starts the gasoline engine, or if the transmission is in neutral and the E button is pressed, the electric propulsion system will go into action.

The 2.3-liter, 5-cylinder internal combustion engine is retained under the hood, and there is no degradation of its rated 136 horsepower. Overall performance is down a bit since the duo weighs 3830 pounds compared to less than 3000 pounds for a normal Audi 100 Quattro. Because of the extra weight on the rear wheels, Audi has installed heavy-duty springs and shock absorbers. Even though the weight is increased, there is no reduction in carrying capacity or payload. Actually, changes to the body and interior are minimal. While a four-wheel-drive design is necessary, the concept would work with a gasoline or diesel engine with either a manual or automatic transmission. Also a compact spare tire is now placed on the side of the luggage compartment. The car also has a "spare" engine since both propulsion systems are completely independent—if one fails you can still drive with the other.

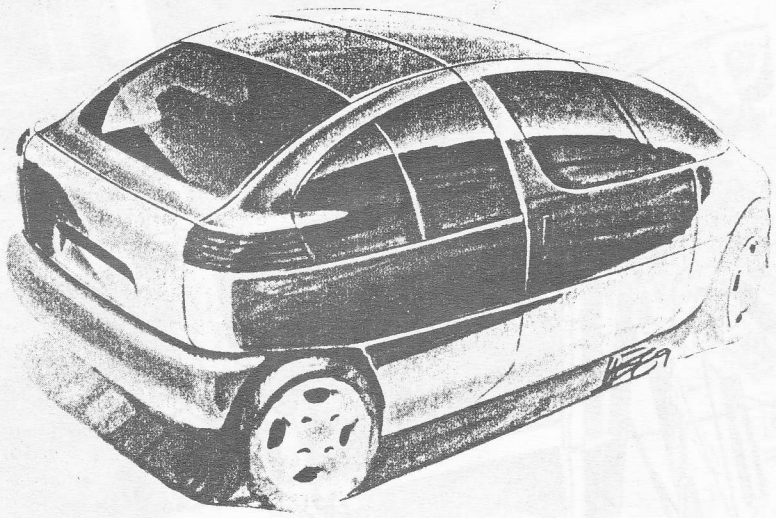
A gearbox is not needed for the electric motor because of its high torque characteristics at low speeds. For example, while the electric motor produces less than 10 percent of the gasoline engine's peak horsepower, it produces 81 ft-lb of torque at start compared to the gasoline engine's peak torque of 140 ft-lb at 4400 rpm. Thus the electric motor can easily accelerate the Audi 100 Avant to 18 mph in 8 seconds.

The car's top speed on electric power is just over 30 mph. While that might seem low, one must remember that there is a high-performance engine still available for highway driving. The car's limited range of under 20 miles on electric power is compensated for by the fact that the internal combustion engine can recharge the batteries while the car is being driven. Because of the Ni-Cd battery's ability to tolerate high charge current rates, the battery pack can be completely recharged in less than 45 minutes.

Currently, Audi estimates the system would add about DM 25,000 ($13,500) to the price of the basic car, about half of this additional cost being for the battery system.

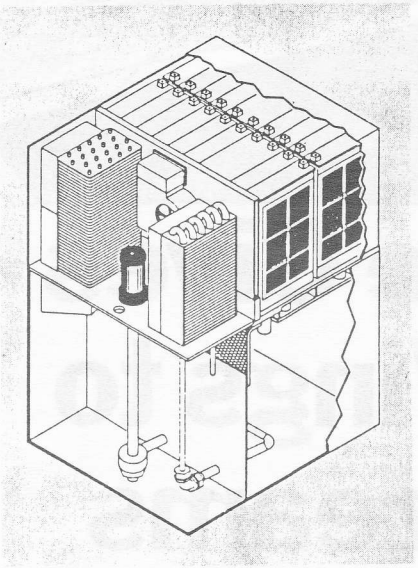


Dual power. The Audi duo's 12.6-hp electric motor fits into the transmission tunnel. Its battery pack is also located in the rear.



Clean Air Transport

LA 301. This 4-passenger car, 2-seat microvan, is based on the $5 million Whisper EV project, a third of which was funded by the Danish government. It uses lead-acid batteries, a 16-hp dc motor, and a propane-fueled auxiliary power unit to achieve a maximum range of 150 miles and a top speed of 60 mph.



Alupower Canada Ltd.

Compact power. The aluminum-air fuel cell system for the LA 301, showing *(right)* the 20 individual cells and *(left)* the condenser and heat exchanger. The pump motor and air blower are located in the center of the left section.

Diesel Drive

Another interesting hybrid is the Diesel/Electric-Hybriddrive system developed jointly by Volkswagen and Bosch. In this system, an electric motor/generator is inserted between the engine and transmission. There is also an automatic clutch on either side of the motor/generator. Normally the internal combustion engine is used for acceleration at speeds above 30 mph. The electric motor is used at the lower performance levels where the internal combustion engine has low efficiency and is a source of higher emissions.

To demonstrate the concept, the hybrid drive has been installed in a VW Golf sedan with a 1.6-liter diesel engine. The 6-kW asynchronous dc motor/generator is integrated with the two clutches so that it increases the length of the engine/gearbox package by a mere 58 mm (2.28 in.). It also weighs only 64 pounds. The additional weight is compensated for by the unit's serving as the starter, flywheel, and alternator.

The electric motor propels the Golf easily at a constant speed of up to 35 mph on level terrain. The motor can accelerate the vehicle, though the acceleration is leisurely but sufficient for quiet and pollution-free driving in urban areas. Although a five-speed gearbox transmission is used, the normal clutch is eliminated since the clutches are automatically activated. VW has located the batteries for the systems in the lower section of the trunk. The system can recover braking energy regeneratively and store it in the battery pack.

The typical duty cycle for urban buses involves a high peak power requirement for acceleration from a stop and for climbing hills, substantially less power for cruising, and then deceleration and braking at the next stop. The engine has to be sized to meet the peak requirement of this duty cycle, and is thus oversized for normal operation, resulting in inefficient fuel usage and unnecessary pollution. Finally, the energy generated while decelerating and braking is wasted.

Magnet-Motor GmbH of Starnberg, West Germany, has developed a propulsion system patterned after diesel-electric locomotives that allows a much smaller diesel engine to be used, resulting in better fuel economy and reduced pollution.

The system consists of a diesel engine that drives an electric generator. The generator's current then either drives an electric motor that propels the bus, or if there is excess electric power, is stored for use when peak power is required, such as when accelerating or climbing a hill. The system also includes regenerative braking so energy is recovered and stored for later use.

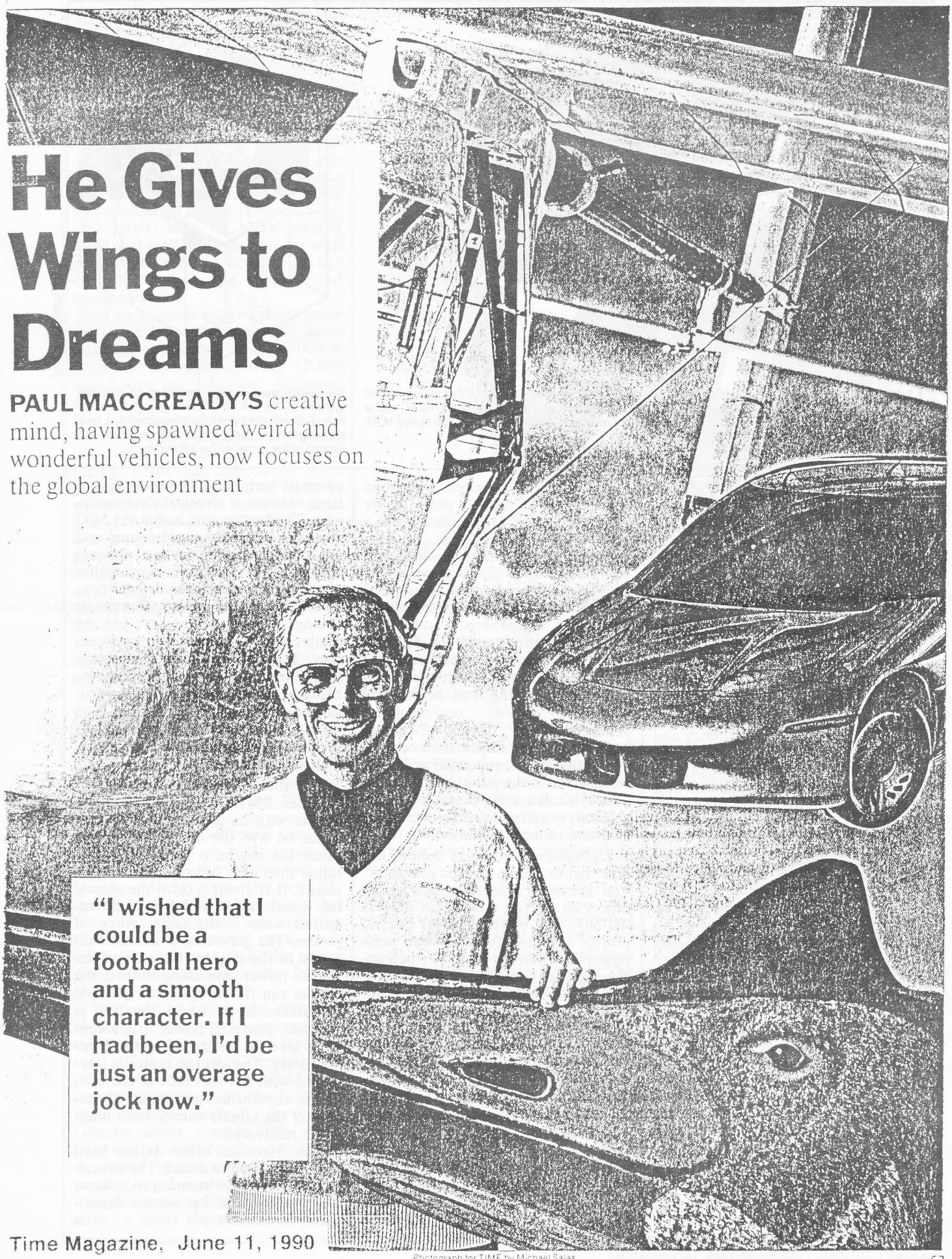
The key element of the system is the Magnetdynamic storage unit, or MDS, which stores energy in a fiberglass flywheel that absorbs and emits energy via a motor/generator in the hollow interior of the rotor. The M/G unit uses an advanced technology called the multiple electronic permanent magnet motor, or MEP. The MEP's rotor is a steel cylinder with high-grade permanent magnets located on its periphery. The stator uses a large number of identical electromagnets. The bottom line is that the M/G produces 2.5 times more torque and greater output than a conventional electric motor and can operate either as a motor or generator. In addition, it has no moving electrical parts or sliding contacts and power can be easily regulated using microprocessors. The MDS has high efficiency even under partial load conditions. Because the MDS rotates on a vertical axis, it is mounted so that it is isolated from the bus, eliminating gyroscopic forces that could affect vehicle operation.

The diesel-electric bus uses a 6-cylinder BMW turbocharged diesel engine with an intercooler that produces 66 kW (90 hp) at 2800 rpm. Since the engine is sized for cruise rather than peak horsepower requirements, it is about a third the size of the diesel engine that would be required were it the only source of power. The generator is attached directly to the engine. Because of the MDS's power smoothing feature, the engine can run at optimum speed at all times. Even when the bus is stopped, electrical power is at a constant level to be stored or used immediately. The electric motor is integrated with the rear axle of the bus. In the current design, about 60 percent of the kinetic energy from braking is recovered.

Two Neoplan urban buses have been converted to diesel. The experimental buses are running in tests at the Stadtwerk (city works department) in Munich. ■

He Gives Wings to Dreams

PAUL MACCREADY'S creative mind, having spawned weird and wonderful vehicles, now focuses on the global environment

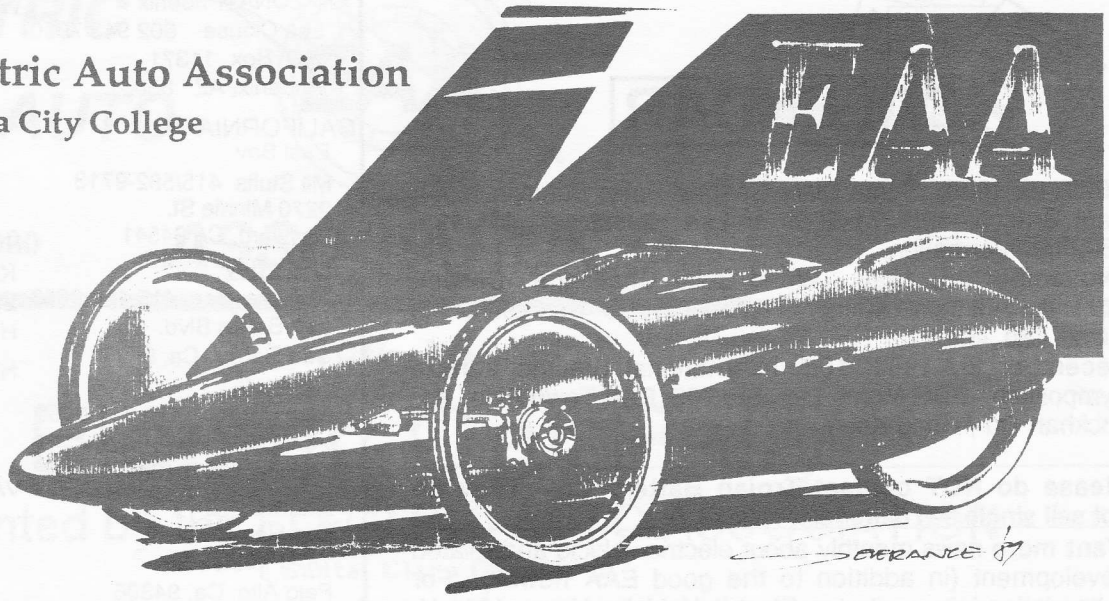


"I wished that I could be a football hero and a smooth character. If I had been, I'd be just an overage jock now."

Photograph for TIME by Michael Salas

Electrathon Race Conference

Sponsored by
The Electric Auto Association
At Pasadena City College



The solar-electric race everyone can afford to enter!

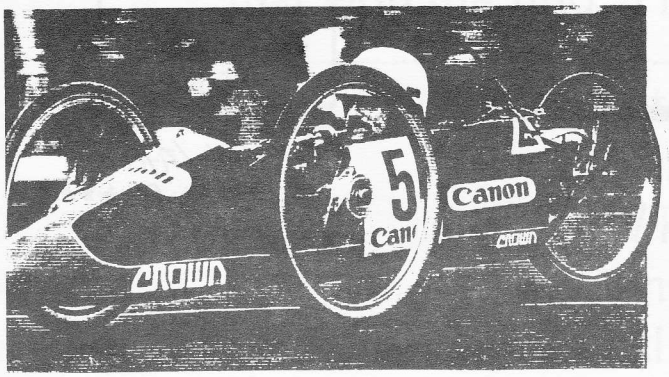
RACE EVENT: Affordable electric vehicles that can be built for as little as $1,500 will be featured in an upcoming event in September of 1991. Solar panels are optional. The Electrathon Races have already been going on in Australia for over a decade. Australian Electrathon champion, Clark Beasley, has moved to Los Angeles to join teams with the Electric Auto Association and promote the first International Electrathon Races. The Electric Auto Association invites all high schools and colleges with automotive or engineering programs to participate in this event and attend the conference.

CONFERENCE: Clark will be heading the conference at PCC to discuss vehicle technology, strategies, race rules and his upcoming book. Races are intended to minimize costs and promote involvement of organizations and individuals who cannot afford exotic technology.

- Battery weight is restricted and exotic batteries excluded to prevent unfair advantage.
- Solar is optional and restricted to 1 square meter (no gallium arsenide cells permitted).
- Throught the cooperation of Cerritos College and the Center for Composite studies participants can build their own bodies at a minimal cost.

Electrathon Race Conferences will be held quarterly at Pasadena City College. For vehicle specifications, rules and regulations, and to get on the Electrathon mailing list contact Clark Beasley at 23725 Oakheath Place, Harbor City, CA 90710, (213) 539-9223.

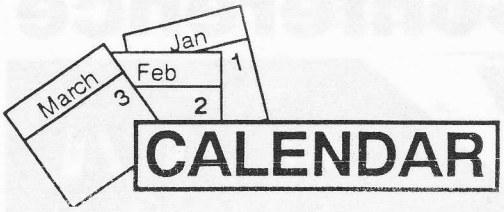
ABOUT THE EAA: Electric Auto Association is a national organization. The Los Angeles Chapter will be meeting monthly at Pasadena City College to promote the involvement of schools and individuals in affordable electric technology.



"Slingshot", built by Australian Electrathon Champion, Clark Beasley, who now promotes EV racing in the USA

TIME AND PLACE: Although EAA meetings are usually held on the first Saturday of every month, the September Meeting will be held on Saturday, September 8, 1990, from 10:00 a.m. to noon in Room R-111 at Pasadena City College, 1570 E. Colorado Blvd., Pasadena, California (see map on reverse)

FOR MORE INFORMATION: Call Irve Weiss (818) 841- 5994 and get on the EAA mailing list!



SEPT 15, 1990. Santa Clara Chapter Rally, Sunnyvale, CA Paul Brasch, 408/371-5969 or Lee Hemstreet, 415/493-5892 for information.

November 25, 1990, World Solar Challenge Darwin-Adelaide, Australia, Energy Promotions, P.O. Box 290 Bribie Island, Qld 4057

December 3-5,1990. 10th International Electric Vehicle Symposium. BDG Mgmt, Ltd. Ste 705, East Town Bldg., 41, Lockhart Rd., Hong Kong

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Please do NOT contact Trojan Battery Co. They do not sell single sell batteries. Thanks.

Want more news monthly about electric vehicle and related development (in addition to the good EAA news?) For subscription info, write to: Electric Vehicles News, 1911 N. Ft. Myer Dr. Ste 703, Arlington, VA 22209

FOR SALE J.& H. G-23 Generator $450. Vester Dick (408) 429-8884.

12 volt, 2.5 to 8 hp motor wanted for small motorcycle. Call 415/932-3364

Ford Escort Jet Electric Car. 96 volt, Series motor, gas heater. Very nice condition; needs batteries / updated controller. $2,500. Maserati Bora 96 Volt, GE Series motor, transistor controller, light, fast and beautiful. Needs new batteries. $6,500. 415/388-0838

Electric Car Marketplace Do you want to BUY an electric car? Do you want to SELL an electric car? Call or write: Solar Electric, 175 Cascade Ct. Rohnert Park, CA 94928 707/586-1987.

Advertisement Rates: 5 Lines for $5.00 - 1/4 page for $15.00
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